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Moral Hazard as an Entry Barrier

Joseph Farrell

No. 387

July 1985

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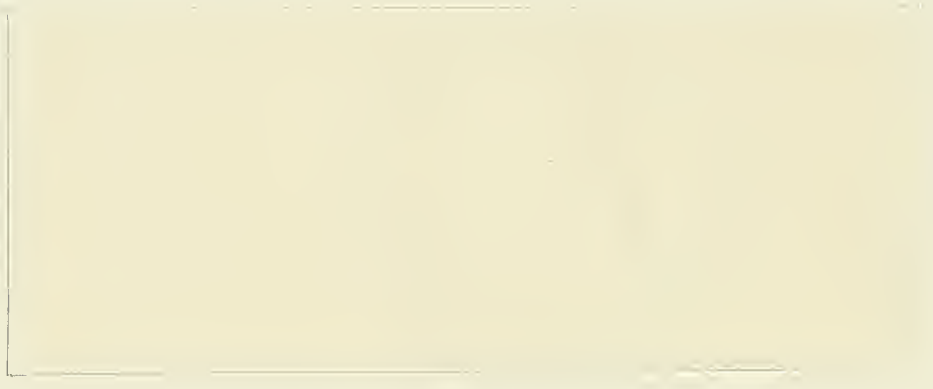

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Abstract

Moral hazard, such as arises in a seller's choice of quality of an experience good, can lead to a barrier to entry. In particular, hit-and-run entry is likely to lead to low quality choice, and, if buyers foresee that, they will be unwilling to buy from an entrant. The scale of entry may affect quality incentives, and therefore introductory offers may assure buyers of an entrant's quality, but this cannot happen under constant returns.

1. Introduction.

Ease of entry is crucial for an industry's performance. Entry constrains monopolies and cartels and guards against poor performance - inadvertent as well as exploitative. New industries begin with entry; and, if sellers differ in efficiency, entry replaces less-efficient earlier participants with more-efficient later arrivals. Modern industrial organization theory stresses the importance of entry conditions, in contrast to earlier emphasis on "actual competition".

One problem facing an entrant may be to persuade buyers that his product is of high quality. In markets for experience goods[1], buyers will know the quality of products they have bought, but not the entrant's. If an entrant sells for a while before buyers learn quality, buyers' fear or suspicion can make entry difficult, enabling an incumbent or an industry to sustain excess profits or inefficiency without inducing entry.

A barrier to entry is an obstacle to efficient contracting between buyers and a potential entrant[2]. Suppose that an industry is providing less consumer surplus than possible. An entrant could enter, provide efficient quality, and make positive profits by offering buyers a slightly better deal than they were getting. But, in some cases, buyers with rational expectations would not be willing to buy from an entrant who claims to be doing that, because his profits would be higher still if he "cheated" by providing low quality. Buyers rationally fear that the entrant will give them a low-quality product. Because of that fear, entry will be impossible.[3] This is our entry barrier.

It is tempting to think that an entrant can commit himself to high quality by sacrificing enough first-period profit that he could not make

positive profits by providing low quality. Thus, introductory offers and costly advertising[4] might seem to deal (at least partly) with this entry barrier. But sunk costs are sunk, and such sacrifices do not themselves affect the incentives to provide high or low quality. However, if introductory offers affect the entrant's first-period sales, then in some circumstances (as we will show) that can affect quality incentives.

The paper is organized as follows. In Section 2, I describe a two-period model of the incentives for an entrant to choose high or low quality. In Section 3, I show how this can lead to an entry barrier. In particular, there is an entry barrier if an entrant's profits are expected to fall to zero once an incumbent firm reacts to entry (after a lag), even though sunk costs are small enough (perhaps zero) so that an honest entrant could profitably enter and later exit, as in the theory of contestable markets. In Section 4, I discuss whether a judicious choice of scale of entry (which might be achieved by introductory offers) can help an entrant persuade rational buyers that his quality will be high.

2. A Model.

We consider a simple model with time divided into two periods. At time zero, an entrant may enter the market. During the first period, his quality is unobservable to buyers. If buyers buy in the first period, then at the end of that period they learn the entrant's quality, which is chosen by the entrant when he enters, and cannot change afterwards[5]. If buyers do not buy in the first period, they will not buy in the second

period either[6].

There are just two[7] possible quality levels, high (H) and low (L). H is the socially efficient quality. (We say that a seller who supplies high quality is "honest".) The low quality L is bad enough that no buyer will ever buy a good that he believes is of low quality[8]. This implies that if an entrant sets low quality, then his optimal strategy at the end of the first period is to leave the market.

If quality is high, we write $\Pi_2(x)$ for the flow of profits[9] to the entrant in the second period, where x is his first-period sales level. (Future profits may depend on x for various reasons, for instance because information may be slow to flow among buyers, or because buyers may be somewhat reluctant to switch among brands.) The value of $\Pi_2(x)$ may also depend on the shape of cost curves, the nature of competition in the market, whether the incumbent responds aggressively, and so on. We will consider various hypotheses below.

If they believe that the entrant will supply high quality, what will buyers do when there is entry? The simplest assumption would be that all will buy from the entrant if he prices below the incumbent. However, this would make it difficult to analyse the effects of the scale of entry, as we wish to do. Accordingly, we suppose that, given the incumbent's price, quality (and responses if any) within the first period, the entrant can sell an amount x at the corresponding price p(x), if he can persuade buyers that his quality is high.

We now introduce some notation. w_1 is the factor by which we multiply a profit flow over the length of the first period in order to get a present value at date zero; w_2 is the corresponding factor for period two. We write f for w_2/w_1, the relative value of the future (the second

period) versus the present. For example, if the first period lasts from time 0 to time T, and there is a constant interest rate r, then a flow of profits equal to y during the first period and to z afterwards is worth

$$(1) \qquad \int_0^T y \exp(-rt)\, dt \quad + \quad \int_T^\infty z \exp(-rt)\, dt$$

$$= \quad (1 - \exp(-rT))y/r \quad + \quad \exp(-rT)z/r$$

so that $w_1 = (1 - \exp(-rT))/r$ and $w_2 = \exp(-rT)/r$, and thus $f = 1/(\exp(rT) - 1)$. Note that as $rT \to 0$, $f \to \infty$, and vice versa.

We write $c(x,q)$ for the flow cost of producing output x at quality q, and $\Delta c(x)$ for $c(x,H) - c(x,L)$, which we assume is strictly positive.

3. Quality Incentives and Entry Barriers.

We consider the quality incentives facing an entrant who gets first-period sales x (we say he enters "at scale x"). If those incentives would cause him to choose low quality, then we suppose that entry at scale x is impossible, because buyers, who understand the incentives, will refuse to buy from the entrant. In other words, we suppose that a scale x of entry is feasible if and only if q=H is optimal for an entrant with first-period sales x. If no feasible x is also profitable, and if some values of x would be profitable without this moral-hazard constraint, then we say that moral hazard creates an entry barrier.

• The Incentives to Honesty:

Given a first-period sales level x, and a first-period price p, the entrant's profits (discounted back to entry) are:

(2) $w_1 (px - c(x,H)) + w_2 \Pi_2(x)$ if $q = H$;

(3) $w_1 (px - c(x,L))$ if $q = L$.

Hence, we get:

•Proposition 1: An entrant who enters at scale x will choose $q = H$ if and only if[10]

(4) $f \Pi_2(x) \geq \Delta c(x)$.

An entrant can profitably enter in such a way as to convince buyers that he is honest if and only if there exists x such that (4) holds and also

(5) $w_1 (p(x)x - c(x,H)) + w_2 \Pi_2(x) > 0$

By contrast, if the entrant could publicly commit himself to high quality in some other way, then he could profitably enter by finding an x such that (5) holds. The difference between the requirement of (5) alone and the requirement of (4) and (5) simultaneously is the entry barrier due to the moral hazard problem.

This entry barrier can take two forms. First, (4) may fail for all positive x. This is certainly the case if $\Pi_2(x) = 0$ for all x:

• Moral Hazard in Hit-and-Run Entry.

Suppose that the optimal strategy for an honest entrant is "hit and run", as in contestability theory. For example, suppose that the incumbent(s) will react very vigorously at or before the end of period one. Then $\Pi_2(x) = 0$, so that (4) can never hold. Entry is blocked, even though the incumbent(s) cannot react instantly, and even though there is no sunk cost of entry.[11]

•Proposition 2: If delayed competitive response makes second-period predicted profits vanish, then honest entry is never the entrant's best strategy. As a result, entry is blocked.

What if $\Pi_2(x)$ is small, but not zero? For example, suppose that the incumbent will react shortly after the beginning of the second period. Or suppose that his reaction will be fairly vigorous, but will not completely eliminate the entrant's profits[12]. Then we still conclude that honesty is not an entrant's best policy, unless perhaps at very small scale ($x \approx 0$) $\Delta c(x)$ becomes small faster than does $\Pi_2(x)$.[13] This leads us to the second form of entry barrier due to moral hazard:

• Scale Effects and Moral Hazard.

It may be that, while some values of x satisfy (4) and some satisfy (5), none satisfies both at once. A leading case is the following. Suppose

that economies of scale ensure that (5) holds only for large x, but for some reason (4) holds only for small x. This latter would be true if $\Pi_2(x)$ is relatively independent of x (information spreads effectively among buyers), but $\Delta c(x)$ increases significantly with x. Then the entrant can either enter in such a way as to get buyers but lose money (small x), or in such a way that honest choice of quality would make money, but dishonest choice of q would make more so he will get no buyers. Profitable entry is thus impossible.

• Competitive Reaction After Beginning of Period 2.

Next, we discuss our problem when the incumbent(s) cannot respond until strictly after the entrant's quality is learned. Then, $\Pi_2(x) > 0$. Moreover, $\Pi_2(x)$ will be a decreasing function of the level of consumer surplus supplied by the incumbent(s).[14] In a simple case, we get an explicit formula for the height of the entry barrier.

Assume that all buyers value the good equally and each buys one unit per unit time, valuing it at v(H) if q = H (and at a negative value if q = L). Incumbent(s) provide a flow of surplus which we write as u*, perhaps (though not necessarily) because they provide high-quality items at a price v(H) - u*. The flow cost of providing quality q to x customers is c(x,q). We write s(x) for the sales (flow) in the second period for an honest entrant who sold at the rate x in the first period; two extreme assumptions would be s(x) = x (individual buyers learn quality, but their information is not passed on) and s(x) = 1 for all x > 0 (all buyers learn the

entrant's quality, however few buyers tried it in the first period). Each of the s(x) buyers in the second period is willing to pay up to v(H) - u* for the entrant's product, until the incumbent responds: this is the price at which a fully-informed buyer is indifferent between the two suppliers.

An honest entrant's value from the second period is

(6) $w_2' \; s(x) \; (\; v(H) - c(x,H)/x - u^* \;)$

where now w_2' represents the value at time zero of a unit cash flow from the beginning of the second period until competition from imitators or incumbents reduces profits to zero.[15]

His temptation to reduce quality is

(7) $w_1 \quad \Delta c(x)$

Therefore, the entrant will be honest provided that

(8) $f \quad s(x)/x \quad (\; v(H) - c(x,H)/x - u^*) \quad \geq \quad \Delta c(x)/x.$

This condition shows that if average costs are constant (given q) and if s(x) is proportional to x, then x will not affect the quality choice. The reader can see how, otherwise, x could be a quality commitment: see Section 4 below. For now, we focus on the proportional case. Writing s for the constant s(x)/x, and c(q) for c(x,q)/x, the condition for q=H becomes

(9) $f \; s \; (v(H) - c(H) - u^*) \quad \geq \quad c(H) - c(L).$

We ask for the value of u* such that entry will be impossible, i.e. such that any entrant will be expected to be dishonest. The critical entry-preventing level is[16]

(10) $u^{**} = v(H) - c(H) - (1/fs)(c(H) - c(L))$.

•Proposition 3: Incumbent(s) can extract excess profits, or sustain inefficiency, to the extent of $(1/fs)(c(H) - c(L))$.

This entry barrier decreases with the relative importance f of the future, and with the rate of transmission s of information among buyers. It increases with the cost difference $(c(H) - c(L))$. "Buyer protection" laws prohibiting low quality items will lower the entry barrier in the high-quality market.[17]

•When will an Incumbent Choose to Prevent Entry?

An important question in limit pricing is whether an incumbent will prevent entry (at some cost), or whether he will prefer to extract his full profits until entry occurs. In our model, an incumbent may be able to extract positive profits while still preventing entry; but he can extract greater current profits if he does not worry about entry. Which choice is preferable for him?

Suppose a monopolist can extract a flow $\Pi(m)$ of profits if unconstrained, a flow $\Pi(b)$ if he must erect an entry barrier, and a flow $\Pi(d)$ if entry occurs. We can suppose that $\Pi(m) > \Pi(b) > \Pi(d)$. If entry would happen at once, then clearly entry prevention is preferable. But

suppose that qualified entrants consider entering this market only sometimes: for instance, suppose that in any short time interval dt in which the market is monopolized there is a probability e dt of an entrant considering entry. Then the monopolist can choose between getting $\Pi(b)$ for ever, which is worth $\Pi(b)/r$, and getting a random stream of profits worth

$$(11) \qquad \Pi(m) \int_0^s \exp(-rt)\, dt \; + \; \Pi(d) \int_s^\infty \exp(-rt)\, dt$$

where s is a random variable with Poisson distribution with rate e. The expected value of this random profit flow is

$$(12) \qquad (\Pi(m) + (e/r)\, \Pi(d))/ (r + e).$$

Comparing these options, the monopolist will choose entry prevention if and only if

$$(13) \qquad \Pi(m) - \Pi(b) < (e/r)(\Pi(b) - \Pi(d)).$$

If $\Pi(m) = v(H) - c(H)$, $\Pi(b) = 1/(fs)\,(c(H) - c(L))$, and $\Pi(d) = 0$, then the condition for choosing to prevent entry becomes

$$(14) \qquad (r - e)\,(v(H) - c(H)) < (r/s)\,(\exp(-rT) - 1)\,\Delta c$$

when we substitute for f.

4. Scale and Introductory Offers as Quality Commitments.

• No Commitment Possible under Constant Returns.

If both $c(x,q)$ and $\Pi_2(x)$ are proportional to x, then (4) either holds for all x or holds for no x. In that case, the scale of entry does not affect quality incentives. Since p occurs in (4) only through x, introductory offers cannot be quality commitments.

•Proposition 4: If costs are proportional to output, and if future profits are proportional to first-period sales, then scale of entry and introductory offers cannot be quality commitments.

• Small-Scale Entry as a Quality Commitment.

If $\Pi_2(x)$ grows less rapidly with x than does $\Delta c(x)$, then (4) will hold for all x less than some critical value x^*. This is the case if, after quality becomes known, profits depend little on the initial scale of entry, while the costs of honest behavior are more sharply increasing in output. In that case, the entrant can commit to high quality by entry at a small scale $x \leq x^*$. The cutoff level x^* is defined by $\Delta c(x^*) = f\ \Pi_2(x^*)$, so it increases with f and with factors that increase Π_2, and decreases with factors that increase Δc.

•Large-Scale Entry as a Quality Commitment.

If $\Pi_2(x)$ grows more rapidly with x than does $\Delta c(x)$, however, then a large scale of entry will act as a commitment to quality. For example, suppose that large-scale entry will fill up a market niche and thus prevent subsequent entry (if quality is high), while small-scale entry will lead to more competition later. Then large-scale entry becomes a commitment to quality.

•Introductory Offers.

We have seen how, if there are not constant returns, scale of entry can affect quality incentives, and how therefore scale may be used strategically to assure buyers of quality. How does this relate to introductory offers?

If buyers are not all alike, then some will be more and others less ready to buy from an entrant. Accordingly, as suggested above, there will be some first-period demand curve facing the entrant, even if all buyers want just one unit of the good and will buy either from the incumbent or from the entrant. Thus, a low introductory price will increase the scale of entry if buyers believe in the entrant's quality. The details will depend on the factors that determine the first-period demand curve. In other words, we view introductory offers as working through their effects on x.[18]

5. Conclusions.

In a simple model, we have shown how moral hazard can act as a barrier to entry. It can do this alone, or by interacting with other aspects of the entry process, especially the decision on scale of entry. Introductory offers considered as pure sacrifices of profits do not affect quality commitments, but if introductory offers affect the scale of entry, that can affect quality incentives. An incumbent can prevent entry even if he is making excess profits, he cannot respond instantly to entry, and there is no sunk cost of entry.

Footnotes.

1. Nelson (1970) introduced this term for goods whose quality is unobservable before purchase, though observable after a buyer has (enough) experience with the good.

2. On this view of barriers to entry, see Grossman (1981) and von Weitzsacker (1980). Grossman's model is static, but his intuitive discussion emphasises contracts in which buyers and entrant agree to abandon the incumbent even though the latter might try to respond with price reductions. Von Weitzacker points out that a coalition of buyers and entrant is immune to predatory price responses, since any losses inflicted on the entrant are more than compensated for by gains to the buyers.

3. The game-theoretic essence of the model can be seen qualitatively as follows (the numbers selected have no significance beyond their relative sizes). Suppose that each of two players, E and B, has a choice of two moves. E can choose "H" or "L" (high or low quality). B can choose "Y" or "N" (buy or don't buy). Payoffs are as follows:

	Y	N
L	(2,-1)	(0, 0)
H	(1, 1)	(0, 0)

The outcome (H, Y), which gives both players positive payoffs, is not an equilibrium, because E will choose to defect to L. Thus each player ends up with zero. If E could commit himself to H before B chose his move, he would do so and each would get 1.

4. For models of the role of sacrifice of profits in guaranteeing honesty or high quality, see for instance Kihlstrom and Riordan (1984), Klein and Leffler (1981), Nelson (1970, 1974, 1978), Rogerson (1983), Shapiro (1983).

5. This assumption - what von Weitzsacker calls extrapolability of quality - is essential for any analysis in which actions in one period indicate quality in another. Why might it be true? Perhaps the most plausible case is that most of the costs of high quality are incurred at the beginning, so that there is no strong incentive to reduce high quality later, while reputations are hard to repair so that there is no incentive to increase quality later.

6. If buyers waited before buying, we would just re-label the point at which the game begins.

7. For a related model with continuously variable quality in which we can show that two qualities suffice, see Farrell (1984).

8. If buyers could experiment with infinitesimally small amounts of an unknown good, this would not be plausible. Likewise, it would not be plausible if buyers merely derived little positive utility from a bad good.

We require that a low-quality item be positively harmful, as might well be the case with drugs, safety equipment, or anything in which using one maker's brand effectively rules out also using another (for instance, auto insurance).

9. If that flow is not constant, then we define $\Pi_2(x)$ so that the present discounted value of second-period profits is the same as that of a steady flow equal to $\Pi_2(x)$.

10. There is a subtle game-theoretic issue here which we skirt. The entrant can be regarded as choosing "simultaneously" both x and q. We have to ask how buyers (who observe x but not q, and care about q) infer q from x. One possible approach is to assume that, whatever x may be, q will be optimal given x. This is our approach. But, given the entrant's beliefs about buyers' rules of inference, there will generically be only one optimal (x,q) choice for him. That means that rationality is already contradicted if a buyer observes a choice of x not consistent with the optimal (x,q). Thus one could suppose that a different choice of x would lead buyers to believe that the entrant is "crazy", and we cannot necessarily assume that q will be optimal given x.

However, if buyers do not know the entrant's beliefs about their rule of inference, then (with enough such uncertainty) any choice of x could be consistent with optimal choice by the entrant. The choice of q given x is more clear-cut.

11. A similar phenomenon may be observed in the contestability model (Baumol, Panzar and Willig, 1982). If entry can only be hit-and-run, because of delayed competitive response by the incumbent, and if buyers suffer a cost of switching custom from incumbent to entrant and then back again, entry may be blocked even if in the conventional sense there is no sunk cost of entry so that the market appears perfectly contestable. However, this latter barrier is limited by the size of the switching cost, so that if the response lag is not too short the problem may be unimportant. The barrier discussed in the text is limited by the difference in consumer value between high and low quality, which seems likely to be much larger.

12. Other factors that could raise an entry barrier by making $f.\Pi_2(x)$ small for all x are the prospect of a shrinking market , and a low value of f, corresponding to large values of r and T. Conversely, in a growing market we might expect $\Pi_2(x)$ to be relatively large (especially if there are expected to be entry barriers in the future!), and this, like small values of rT, will make it easier for an entrant now.

13. This exception may not be very useful, however, since there are likely to be some fixed costs, so that very small-scale entry is unprofitable.

14. An alternative interpretation is that we are considering the actions of a first entrant into a new market, who may be imitated after a while. Then, $\Pi_2(x)$ is positively related to the need for the good, as well as negatively related to the ease of imitation, etc.

15. If competition will reduce profits, but not to zero, then w_2' is the number such that the present value of the second-period profits is as

given.

16. We assume that the result of our calculation is less than v(H) - c(H). If not, then the incumbent can extract the whole surplus without inducing entry.

17. This is because it makes "cheating" less attractive. For a similar idea, see Shapiro (1983).

18. What about the argument that lowering the introductory price until dishonest first-period profits are zero will make buyers believe in honest quality? Lowering the introductory price does make dishonest entry less attractive; but it also makes honest entry less attractive by the same amount, and thus does not affect the incentives for honesty. In other words, the fact that p does not appear in (4) shows that a pure sacrifice of first-period profits, for instance by introductory offer, does not change quality incentives.

However, a pure sacrifice can signal something exogenous that relates to quality. Milgrom and Roberts (1984) and Farrell (1984, Section IV) have models of this kind. In the model of Milgrom and Roberts, quality is itself exogenous, and high-quality producers are more profitable than low-quality producers. Hence a sacrifice of profits (by introductory offer or by costly and otherwise useless advertising) can convince buyers that quality is high. In Farrell (1984), entrants differ in some other unobservable attribute, such as cost structure or discount rate, that will affect the quality decision. In some cases, a sacrifice of profit shows "good news" about that attribute, making a choice of high quality more likely. For instance, if variations that make profits higher such as lower values of r also make (4) more likely to hold, then profit sacrifices are desirable signals.

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